



# Industrial Maintenance Technology

Program of Studies  
2015-2016



## Industrial Maintenance Technology

Program Area Course Title	Post- Secondary Connection	Valid Course Code	Recommended Grade Level				Recommended Credit
			9	10	11	12	
Advanced Hydraulic Systems	MST 200	470316			X	X	1
Advanced Pneumatic Systems	MST 204	470326			X	X	1
Applied Machining 1 (Ind. Maint.)	CMM120	470360			X	X	1
Basic Blueprint Reading	BRX 120	499920	X	X	X	X	.5
Basic Troubleshooting	BTX 205	499925			X	X	.5
Blueprint Reading for Machinists	BRX 112	470921	X	X	X	X	1
Cooling and Dehumidification (Ind. Maint.)	ACR 250	470361			X	X	1
CO-OP I (Ind. Maint.)	IMT 199	470305			X	X	1
Electrical Components	ACR 130	470358					1
Fluid Power	FPX 100	470321		X	X	X	1
Fundamentals of Machine Tool – A (for Maintenance)	CMM 110	470313	X	X	X	X	.5 - 1
Fundamentals of Machine Tool – B (for Maintenance)	CMM 112	470314	X	X	X	X	.5 - 1
Gas Metal Arc Welding (Ind. Maint.)	WLD 140 (ind. Maint)	470367	X	X	X	X	1
Heating and Humidification (Ind. Maint.)	ACR 260	470363			X	X	1
HVAC Electricity (Ind. Maint.)	ACR 102	470365		X	X	X	1
Industrial Maintenance Electrical Motor Controls	IMT 220	470348			X	X	1
Industrial Maintenance Electrical Principles	IMT 110	470322		X	X	X	1
Industrial Maintenance of PLC's	IMT 230	470330			X	X	1
Internship I (Ind.Maint)	IMT 198	470308			X	X	1-3
Maintaining Industrial Equipment	IMT 150	470318	X	X	X	X	1
Refrigeration Fundamentals (Ind. Maint.)	ACR 100	470349	X	X	X	X	1
Robotics and Industrial Automation (Ind. Maint.)	ELT 260	470351			X	X	1
Shielded Metal Arc Welding (Ind. Maint.)	WLD 120	470354	X	X	X	X	1
Shop Management	MOT 130	470301		X	X	X	.5
Special Topics – Industrial Maintenance Technology	IMT 290	470336	X	X	X	X	.5 - 1
Welding for Maintenance	IMT 100	470328	X	X	X	X	1

Last revised May 15, 2015

## Overview of Industrial Maintenance Technology

### Purpose

The vision of Industrial Maintenance is promote safety and performance standards, enhance leadership, and provide relevant curriculum vital to the education of all students.

Industrial Maintenance is the lifeline of today's industry. Industrial Maintenance programs will provide a structured yet flexible training program for those interested in developing the technical skills required to keep industry operating. Maintenance technicians will be trained to be proficient in many different areas including plant safety, electromechanical equipment, reading technical schematics, bearings, lubrication, centrifugal pumps, alignment, piping systems, mechanical drives, hydraulics/pneumatics, industrial electricity, motor controls, vibration analysis, troubleshooting, machining and welding. The field of Industrial Maintenance employs techniques from physics, engineering, and decision analysis for the repair and maintenance of all equipment used in industrial facilities.

Industrial Maintenance Technology will:

- Operate as the pathway for manufacturing skill technology in schools.
- Operate as the venue for nationally recognized industry standard training.
- Provide a critical link in school to employment or postsecondary education.
- Develop stronger relationships with the community in terms of mutual advocacy, cooperative field experiences, employment placement, and support for relevant student organizations and competitions.
- Represent a necessary component in the education of all students.
- Require and promote critical thinking and problem solving.
- Offer nationally recognized industry certifications.
- Offer a flexible curriculum based on standards that adapt to change and meet the needs of industry.
- Integrate common core to insure that students develop excellent written and verbal communications skills, occupational skills, and scientific problem-solving skills.

### Career Pathway:

- *Maintenance Mechanic*
- *Electrical Technician*
- *Maintenance Machinist*
- *Fluid Power Mechanic*
- *Refrigeration Technician*
- *Welding Maintenance Technician*
- *IMT TRACK (Manufacturing)*
- *TRACK Industrial Maintenance Electrical Pathway*

### Standards Based Curriculum

The Industrial Maintenance Technology curriculum is composed of standards based competencies. All Industrial Maintenance Technology programs incorporate industry and common core standards thus increasing the student's qualifications toward successful employment.

Alignment of the Industrial Maintenance Technology curriculum with nationally recognized industry standards and the common core standards provides optimal preparation for students to acquire an industry certification.

Communities understand that this preparation provides better career opportunities for students and the demands of today's workforce for the 21<sup>st</sup> century.

## **2014 – 2015 Valid Industry Certification and KOSSA List**

### **Kentucky Occupational Skill Standards**

The Kentucky Occupational Skill Standards are the performance specifications that identify the knowledge, skills, and abilities an individual needs to succeed in the workplace. Identifying the necessary skills is critical to preparing students for entry into employment or postsecondary education. These standards describe the necessary occupational, academic, and employability skills needed to enter the workforce or post-secondary education in specific career areas. There is an ongoing effort to continue to refine these standards by which exemplary Career and Technical Education Programs are evaluated and certified. This helps insure that curriculum meets industry specifications.

### **Interdisciplinary Courses**

The Kentucky graduation requirements allow for interdisciplinary or applied courses to substitute for specific academic courses required for graduation. In the manufacturing curriculum IMT courses may count as the 4<sup>th</sup> math credit to meet graduation requirements.

### **Work Based Learning**

Cooperative experience, internships, shadowing and mentoring opportunities provide depth and breadth of learning in the instructional program and allow students to apply the concepts learned in the classroom. The Work Based Learning Manual is available on the KDE webpage: [www.education.ky.gov](http://www.education.ky.gov).

### **Student Organizations and Competitions**

Participation in SkillsUSA competitions provides a vehicle for students to employ higher order thinking skills, interact with high-level industry representatives and enhance leadership skills through participation in regional, state and national competitive events and activities.

# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

## MAINTENANCE MECHANIC

### CIP 47.0303.01

**PATHWAY DESCRIPTION:** Maintenance Mechanics perform machine setup, troubleshooting, repairs and preventive maintenance service; including but not limited to, mechanical, electrical, pneumatic and hydraulic systems for industrial production and processing machinery and equipment. Reads and interprets equipment manuals and work orders to perform required maintenance and service. Analyses and inspects equipment, structures, or materials to identify the cause of errors or other problems or defects.

BEST PRACTICE CORE	EXAMPLE ILP-RELATED CAREER TITLES
<p><i>Foundational Skills Necessary for Career-Ready Measure: (KOSSA/Industry Certification)</i></p> <p><i>Complete (3) <b>THREE CREDITS:</b></i></p> <ul style="list-style-type: none"> <li>• 470321 Fluid Power</li> <li>• 470322 Industrial Maintenance Electrical Principles</li> <li>• 470318 Maintaining Industrial Equipment</li> </ul> <p><i>Choose (1) <b>ONE CREDIT</b> from the following:</i></p> <ul style="list-style-type: none"> <li>• 470348 Industrial Maintenance Electrical Motor Controls</li> <li>• 499925 Basic Troubleshooting*</li> <li>• 470301 Shop Management*</li> <li>• 499920 Basic Blueprint Reading*</li> <li>• 470351 Robotics and Industrial Automation (Ind Maint)</li> <li>• 470328 Welding for Maintenance</li> <li>• 470313 Machine Tool A (IMT)</li> <li>• 219901 Introduction to Engineering Design (<b>PLTW</b>)</li> <li>• 470308 Internship (Ind Maint) <u>OR</u></li> <li>• 470305 Cooperative Education I (Ind Maint)</li> </ul> <p>Note: (PLTW) courses require an agreement between Project Lead the Way and the Local School District.</p> <p>Note: (*) Indicates half-credit (.5) course</p>	<p>Maintenance Mechanic</p> <p>Maintenance Inspector</p> <p>Maintenance Supervisor</p> <p>Industrial Engineer Tech</p> <p>Mechanical Engineer</p>

# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

### ELECTRICAL TECHNICIAN

#### CIP 47.0303.02

**PATHWAY DESCRIPTION:** Electrical technicians apply electrical theory and related knowledge to diagnose and modify developmental or operational electrical machinery and electrical control equipment and circuitry in industrial or commercial plants and laboratories: Assembles and tests experimental motor-control devices, switch panels, transformers, generator windings, solenoids, and other electrical equipment and components according to engineering data and knowledge of electrical principles.

#### BEST PRACTICE CORE

*Foundational Skills Necessary for Career-Ready Measure:  
(KOSSA/Industry Certification)*

*Complete (3) **THREE CREDITS:***

- 470322 Industrial Maintenance Electrical Principles
- 470348 Industrial Maintenance Electrical Motor Controls
- 470330 Industrial Maintenance of PLC

*Choose (1) **ONE CREDIT** from the following:*

- 499925 Basic Troubleshooting\*
- 470301 Shop Management\*
- 499920 Basic Blueprint Reading\*
- 470328 Welding for Maintenance
- 470318 Maintaining Industrial Equipment
- 470351 Robotics and Industrial Automation
- 219901 Introduction to Engineering Design (**PLTW**)
- 470308 Internship (Ind Maint) OR
- 470305 Cooperative Education I (Ind Maint)

Note: (PLTW) courses require an agreement between Project Lead the Way and the Local School District.

Note: (\*) Indicates half-credit (.5) course

#### EXAMPLE ILP-RELATED CAREER TITLES

Electrical Technician  
Electrical Supervisor  
Electrical Engineer

# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

#### MAINTENANCE MACHINIST

##### CIP 47.0303.03

**PATHWAY DESCRIPTION:** Maintenance Machinists set up and operate a variety of machine tools, and fits and assembles parts to fabricate or repair machine tools and maintain industrial machines, applying knowledge of mechanics, shop mathematics, metal properties, layout, and machining procedures. Observes, listens and diagnoses operating machinery or equipment to correct machine malfunction and determine need for adjustment or repair.

#### BEST PRACTICE CORE

#### EXAMPLE ILP-RELATED CAREER TITLES

*Foundational Skills Necessary for Career-Ready Measure:  
(KOSSA/Industry Certification)*

*Complete (3) **THREE CREDITS:***

- 470921 Blueprint Reading for Machinist
- 470313 Machine Tool A (IMT)
- 470314 Machine Tool B (IMT)

*Choose (1) **ONE CREDIT** from the following:*

- 470360 Applied Machining I
- 470301 Shop Management\*
- 499925 Basic Troubleshooting\*
- 499920 Basic Blueprint Reading\*
- 470318 Maintaining Industrial Equipment
- 470328 Welding for Maintenance
- 470322 Industrial Maintenance Electrical Principles
- 219901 Introduction to Engineering Design (**PLTW**)
- 470308 Internship (Ind Maint) OR
- 470305 Cooperative Education I (Ind Maint)

Note: (PLTW) courses require an agreement between Project Lead the Way and the Local School District.

Maintenance Machinist  
Maintenance Mechanic  
Mechanical Engineer  
Industrial Engineer

# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

### FLUID POWER MECHANIC

#### CIP 47.0303.04

**PATHWAY DESCRIPTION:** Fluid Power Mechanics fabricate, assembly, service, maintain, repair, and tests industrial hydraulic equipment. Applies knowledge of hydraulic, pneumatic, and electrical principles to test equipment, and analyzes and records data, such as fluid pressure, flow measure, and power loss due to friction and parts wear. The fluid power mechanic understands hydraulic symbols, reads system schematics, understands electrical principles, and is skilled in test procedures and instrumentation.

#### BEST PRACTICE CORE

*Foundational Skills Necessary for Career-Ready Measure:  
(KOSSA/Industry Certification)*

*Complete (3) **THREE CREDITS:***

- 470321 Fluid Power
- 470316 Advanced Hydraulic Systems
- 470326 Pneumatic Systems

*Choose (1) **ONE CREDIT** from the following:*

- 499925 Basic Troubleshooting\*
- 499920 Basic Blueprint Reading\*
- 470301 Shop Management\*
- 470351 Robotics and Industrial Automation
- 470322 Industrial Maintenance Electrical Principles
- 470318 Maintaining Industrial Equipment
- 470328 Welding for Maintenance
- 219901 Introduction to Engineering Design (**PLTW**)
- 470308 Internship (Ind Maint) OR
- 470305 Cooperative Education I (Ind Maint)

Note: (PLTW) courses require an agreement between Project Lead the Way and the Local School District.

Note: (\*) Indicates half-credit (.5) course

#### EXAMPLE ILP-RELATED CAREER TITLES

Industrial Hydraulic Technician  
Mechanical Engineer  
Industrial Engineer  
Pneumatic Specialist  
Fluid Power Supervisor  
Hydraulic Engineer



# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

## REFRIGERATION TECHNICIAN

### CIP 47.0303.05

**PATHWAY DESCRIPTION:** Refrigeration technician's service, and repair refrigeration systems and equipment such as condensing units, compressors, and evaporators. Some duties of the job include connecting refrigeration lines and electrical power sources, handling hazardous refrigerant substances, and checking systems and equipment for leaks. Technicians will often use system blueprints or manufacturers' instructions to complete a job. When working on air conditioning and refrigeration systems, technicians must follow government regulations regarding the conservation, recovery, and recycling of refrigerants. This includes the proper handling and disposal of fluids and pressurized gases.

#### BEST PRACTICE CORE

*Foundational Skills Necessary for Career-Ready Measure:  
(KOSSA/Industry Certification)*

*Complete (3) **THREE CREDITS:***

- 470349 Refrigeration Fundamentals (IMT)
- 470365 HVAC Electricity (IMT)
- 470358 Electrical Components

*Choose (1) **ONE CREDIT** from the Following:*

- 499925 Basic Troubleshooting\*
- 470363 Heating and Humidification (IMT)
- 470361 Cooling and Dehumidification (IMT)
- 470318 Maintaining Industrial Equipment
- 499920 Basic Blueprint Reading\*
- 470301 Shop Management\*
- 219901 Introduction to Engineering Design (**PLTW**)
- 470308 Internship (Ind Maint) OR
- 470305 Cooperative Education I (Ind Maint)

Note: (PLTW) courses require an agreement between Project Lead the Way and the Local School District.

Note: (\*) Indicates half-credit (.5) course

#### EXAMPLE ILP-RELATED CAREER TITLES

Refrigeration Specialist  
Mechanical Engineer  
Industrial Engineer  
Refrigerant Supervisor  
Refrigeration Engineer

# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

## WELDING MAINTENANCE TECHNICIAN

### CIP 47.0303.06

**PATHWAY DESCRIPTION:** Maintenance Welding Technicians layout, fabricate, set up and weld metals in all positions. Welding technicians must operate all types of welding equipment and apply safety first and comply with all OSHA guidelines and regulations. They read blueprints, apply mechanical skills, calculate shop mathematics and know the metal properties, to perform welding procedures to meet industry specifications. Additional skills that enhance employability opportunities are diagnosing operating machinery or equipment to correct machine malfunction and determine need for adjustment or repair.

### BEST PRACTICE CORE

*Foundational Skills Necessary for Career-Ready Measure:  
(KOSSA/Industry Certification)*

*Complete (3) **THREE CREDITS:***

- 470328 Welding for Maintenance
- 470354 Shielded Metal Arc Welding
- Gas Metal Arc Welding (IMT)

*Choose (1) **ONE CREDIT** from the Following:*

- 499925 Basic Troubleshooting\*
- 470322 Industrial Maintenance Electrical Principles
- 470318 Maintaining Industrial Equipment
- 470313 Machine Tool A (IMT)
- 499920 Basic Blueprint Reading\*
- 470301 Shop Management\*
- 219901 Introduction to Engineering Design (**PLTW**)
- 470308 Internship (Ind Maint) OR
- 470305 Cooperative Education I (Ind Maint)

Note: (PLTW) courses require an agreement between Project Lead the Way and the Local School District.

Note: (\*) Indicates half-credit (.5) course

### EXAMPLE ILP-RELATED CAREER TITLES

Mechanical Engineer  
Industrial Engineer  
Maintenance Supervisor  
Welding Maintenance Engineer  
Master Maintenance

# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

#### IMT TRACK

#### CIP 48.0500.99

**PATHWAY DESCRIPTION:** The Industrial Maintenance Manufacturing TRACK is designed as a pre-apprenticeship pathway for technical students to enter industry. Through the collaboration of local industry, technical school, program instructor, student and parents, a pre-apprenticeship agreement is signed. Local industry chooses 4 courses related to the required skills that will prepare the student to enter a four year apprenticeship sponsored by the company.

Upon graduation the student under the discretion of the company; may be awarded reduced apprenticeship time or start at a higher wage.

#### BEST PRACTICE CORE

*Foundational Skills Necessary for Career-Ready Measure:  
(KOSSA/Industry Certification)*

*Complete (4) **FOUR CREDITS:***

- (4)- Core courses chosen from the IMT valid course list by the company sponsoring a State Registered Apprenticeship.

#### EXAMPLE ILP-RELATED CAREER TITLES

Engineer Technician  
Maintenance Mechanic  
Fluid Power Mechanic  
Maintenance Machinist  
Refrigeration Technician  
Electrical Engineer  
Industrial Engineer  
Mechanical Engineer

The Tech Ready Apprentices for Careers in Kentucky (*TRACK*) pre-apprenticeship program is a partnership between The Kentucky Department of Education's Office of Career and Technical Education and The Kentucky Labor Cabinet to provide pre-apprenticeship career pathway opportunities into registered apprenticeship programs to secondary students. This is a business and industry driven program to create a pipeline for students to enter post-secondary apprenticeship training.

Upon successful completion, the student will be awarded an industry certification by the employer or training organization through The Kentucky Labor Cabinet and all on-the-job hours worked will be counted towards the apprenticeship, if applicable. The certification will also count towards the local school district's college and career ready accountability index.

The specifics of the TRACK program vary and interested parties will need to confer with the Office of Career and Technical Education for the implementation process. There are no costs involved except wages for the student employee. The employer must have a registered apprenticeship program with The Kentucky Labor Cabinet. For more information, please refer to:

<http://education.ky.gov/CTE/cter/Pages/TRACK.aspx>

As career pathways continue to expand, the ultimate rationale is that if an employer is willing to implement a Registered Apprenticeship program, a pipeline at the secondary level can be developed utilizing the TRACK program.

# INDUSTRIAL MAINTENANCE TECHNOLOGY

## CAREER PATHWAYS

### 2015-2016

#### TRACK INDUSTRIAL MAINTENANCE ELECTRICAL PATHWAY

#### CIP 47.0303.99

**PATHWAY DESCRIPTION:** The TRACK Industrial Maintenance Electrical Pathway is designed as a pre-apprenticeship pathway for technical students to enter a USDOL Registered Electrical Apprenticeship program. Representatives from Kentucky Electrical Apprenticeship Committees chose 4 courses from the IMT valid course list. These courses will prepare the student with the required skills to enter a four year Electrical Apprenticeship. Additional courses are also listed enhancing the students skill set. Each student must pass an End of Program assessment and complete 8 OSHA Safety modules listed on The Kentucky Labor Cabinet website. Upon completion the student will receive a pre-apprenticeship industry certification and be considered for an interview for an Electrical Apprenticeship. Upon acceptance into an apprenticeship program, the sponsoring entity will determine how much credit is awarded to the student for prior learning. The OCTE Manufacturing consultant will be able to provide a list of participating ELECTRICAL apprenticeship programs.

#### BEST PRACTICE CORE

#### EXAMPLE ILP-RELATED CAREER TITLES

*Foundational Skills Necessary for Career-Ready Measure:  
(KOSSA/Industry Certification)*

***Complete (4) FOUR REQUIRED CREDITS:***

- 470322 Industrial Maintenance Electrical Principles
- 470348 Industrial Maintenance Electrical Motor Controls
- 470330 Industrial Maintenance of PLC
- 470318 Maintaining Industrial Equipment

***Additional coursework to ENHANCE pathway:***

- 499925 Basic Troubleshooting\*
- 470365 HVAC Electricity (Ind.Maint)

See information specific to TRACK on previous page.


Note: (\*) Indicates half-credit (.5) course

Engineer Technician  
Maintenance Mechanic  
Fluid Power Mechanic  
Maintenance Machinist  
Refrigeration Technician  
Electrical Engineer  
Industrial Engineer  
Mechanical Engineer

<b>COMPLEMENTARY OR ADVANCED COURSEWORK BEYOND IMT PATHWAY(s)</b>
Upon completion of a pathway, additional coursework to enhance student learning is encouraged. Credits earned in Advanced or Complementary Coursework “Beyond the Pathway” may not be substituted for pathway courses in order to achieve Preparatory or Completer status.
<ul style="list-style-type: none"><li>• Career Options</li></ul>
<ul style="list-style-type: none"><li>• JAG Courses</li></ul>
<ul style="list-style-type: none"><li>• 470336 Special Topics – Industrial Maintenance Technology</li></ul>

# KENTUCKY CAREER PATHWAY/PROGRAM OF STUDY TEMPLATE

<b>COLLEGE/UNIVERSITY:</b>		KCTCS/Kentucky Universities			<b>CLUSTER:</b> Manufacturing					
<b>HIGH SCHOOL (S):</b>		Kentucky High			<b>PATHWAY:</b> Maintenance Manager/Supervisor					
		OCTE ATC/CTC			<b>PROGRAM:</b> Industrial Maintenance Technology					

 **CCTI**  
 College and Career Transitions Initiative  
 Funded by the U. S. Department of Education  
 (V0518020001)  
 Revised Jan. 2005  
 October, 2006-CTE Kentucky

## Advanced Hydraulic Systems

### Valid Course Code: 470316

**Course Description:** The advanced hydraulic systems class will cover design, repair, and troubleshooting of hydraulic systems.

*Prerequisites: Fluid Power - 470321*

Content/Process
<p><b>Students will:</b></p> <ol style="list-style-type: none"> <li>1. Practice and perform safe shop procedures at all times.</li> <li>2. Apply the technical math required for employment opportunities in machining.</li> <li>3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.</li> <li>4. Describe the properties of hydraulic fluid.</li> <li>5. Describe how an accumulator performs in a circuit.</li> <li>6. Install and operate an accumulator into a circuit.</li> <li>7. Install and operate a pilot-operated check valve.</li> <li>8. Install and operate a pressure-compensated flow control valve.</li> <li>9. Install and operate a pilot-operated directional control valve.</li> <li>10. Install and operate a pressure port check valve.</li> <li>11. Install and operate a cam-operated valve.</li> <li>12. Hook up and operate unloading circuits.</li> <li>13. Install and operate by remote a pilot-operated pressure control valve.</li> <li>14. Describe transducers.</li> <li>15. Describe electrohydraulic servo valve characteristics.</li> <li>16. Operate an electrohydraulic servo valve.</li> <li>17. Install a hydraulic pump and align.</li> <li>18. Repair a hydraulic cylinder.</li> <li>19. Choose a hydraulic cylinder for a specific application.</li> <li>20. Interpret hydraulic schematics.</li> <li>21. Troubleshoot a hydraulic circuit.</li> <li>22. Design a hydraulic circuit.</li> <li>23. Repair valves.</li> </ol>
Connections
<ul style="list-style-type: none"> <li>• Common Core State Standards</li> <li>• Common Core Technical Standards</li> <li>• KOSSA</li> <li>• New Generation Science Standards</li> <li>• National Center for Construction and Education Research</li> <li>• KCTCS Course: MST 200</li> <li>• CTSO - SkillsUSA</li> </ul>

## Advanced Pneumatic Systems

Valid Course Code: 470326

**Course Description:** Design, repair, and troubleshooting of pneumatic systems will be covered in this course.

*Prerequisites: Fluid Power - 470321*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Repair a pneumatic cylinder.
5. Choose a pneumatic cylinder for a specific application.
6. Interpret pneumatic schematics.
7. Construct basic air logic circuits.
8. Identify symbols and devices used in air logic circuits.
9. Install and operate a check valve.
10. Install and operate a four-way pilot-operated directional control valve (DCV).
11. Install and operate a push button DCV.
12. Install and operate a cam-operated DCV.
13. Design a pneumatic system.
14. Disassemble an air compressor.
15. Repair valves.
16. Troubleshoot a pneumatic system.
17. Test pneumatic components for proper operation.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: MST 204
- CTSO - SkillsUSA



## Applied Machining I (Ind.Maint)

Valid Course Code: 470360

**Course Description:** Consists of intermediate level skills using machining machines and surface grinders. It will include the selection of grinding wheels. Applications in milling, lathe, benchwork, and utilizing gauge blocks and the sine bar are covered in this course. Surface grinding and abrasives are introduced and properties of metals are discussed.

*Prerequisite: Fundamentals of Machine Tool A  
Fundamentals of Machine Tool B*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Machine and finish holes on the vertical and horizontal mills.
5. Cut and finish different types of keyseats.
6. Select and use different types of milling cutters.
7. Select and perform basic grinding operation.
8. Machine holes on a vertical mill.
9. Form mill on a vertical mill.
10. Mill key seats.
11. Mill an angle on a vertical mill.
12. Cut and finish holes on vertical and horizontal mills.
13. Demonstrate the care and safe use of machine grinders.
14. Select grinding wheels.
15. Classify metals and metal shapes.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: CMM 120
- CTSO - SkillsUSA

## Basic Blueprint Reading

Valid Course Code: 499920

**Course Description:** This course presents basic applied math, lines, multiview drawings, symbols, various schematics and diagrams, dimensioning techniques, sectional views, auxiliary views, threads and fasteners, and sketching typical to all shop drawings. Safety will be emphasized as an integral part of the course.

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Review math concepts (fractions and decimals).
5. Identify the alphabet of lines.
6. Identify multiple views.
7. Arrange multiple views.
8. Arrange two-view drawings.
9. Identify one-view drawings.
10. Arrange and identify auxiliary views.
11. Demonstrate the use of size and location dimensions.
12. Demonstrate proper dimensions of cylinders and arcs.
13. Size dimensions of holes and angles.
14. Locate dimensions for centering of holes, points, and centers.
15. Interpret the base line dimensions on drawings.
16. Identify half, full, and removed sections.
17. Identify electrical schematic and diagram symbols.
18. Identify welding symbols and equipment.
19. Interpret ordinate and tabular dimensions.
20. Set tolerances using geometric dimensioning techniques.
21. Sketch parts with irregular shapes.
22. Sketch oblique views of various parts.
23. Sketch and dimension shop drawings.
24. Dimension parts using shop notes.
25. Calculate tolerances.
26. Identify labeling of various screw threads.
27. Calculate tapers and machined surfaces.
28. Interpret connections and flow of various electrical, hydraulic, and pneumatic schematics and diagrams.

### Connections

- Common Core State/Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: BRX 120
- CTSO - SkillsUSA

## Basic Troubleshooting

Valid Course Code: 499925

**Course Description:** This course explores the science of troubleshooting and the importance of proper maintenance procedures; how to work well with others, aids in communication, and trade responsibilities; examines actual troubleshooting techniques, aids in troubleshooting, and how to use schematics and symbols; focuses on specific maintenance tasks such as solving mechanical and electrical problems, breakdown maintenance, and the hows and whys of planned maintenance.

*Prerequisites: Consent of Instructor*

### Content/Process

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Explain the reason efficient troubleshooting is important in a production plant.
5. List the steps in troubleshooting a machine/system.
6. Demonstrate good communication skills when dealing with plant personnel.
7. List the questions that should be asked when a machine/system fails.
8. List the signs of a machine in need of service.
9. List the information that should be recorded in a machine equipment record.
10. Identify calibration standards.
11. Identify different troubleshooting test equipment.
12. Use schematics when troubleshooting.
13. Identify differences in schematics when troubleshooting.
14. Use a troubleshooting chart.
15. Identify bearing wear problems.
16. Identify pump failure problems and solutions.
17. Identify types of hosing.
18. Identify current voltage characteristics of wire.
19. Apply all safety rules when working with electrical equipment.
20. Identify a pictorial diagram, blocking diagram, and schematic diagram.
21. Demonstrate how to troubleshoot an electrical problem.
22. List preventive maintenance procedures.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: BTX 205
- CTSO - SkillsUSA

## Blueprint Reading for Machinists

Valid Course Code: 470921

**Course Description:** Blueprint Reading for Machinists provides the student with a beginning and advanced series of lectures, demonstrations, and practice exercises in the study of prints. Safety will be emphasized as an integral part of this course.

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate competency in mathematical fraction and decimal problems.
5. Identify the alphabet of lines.
6. Identify multiple views.
7. Arrange multiple views.
8. Arrange two view drawings.
9. Identify one view drawings.
10. Arrange and identify auxiliary views.
11. Demonstrate the use of size and location dimensions.
12. Demonstrate proper dimensions of cylinders and arcs.
13. Size dimensions of holes and angles.
14. Locate dimensions for centering of holes, points, and centers.
15. Interpret the base line dimensions on drawings.
16. Calculate tolerances.
17. Identify labeling of various screw threads.
18. Calculate tapers and machined surfaces.
19. Dimension parts using shop notes.
20. Identify half, full, and removed sections.
21. Interpret ordinate and tabular dimensions.
22. Set tolerances using geometric dimensioning techniques.
23. Sketch parts with irregular shapes.
24. Sketch oblique views of various parts.
25. Sketch and dimension shop drawings.
26. Demonstrate visualizing techniques of multiple views.
27. Identify line types used in combinations.
28. Identify standards listings on working drawings.
29. List procedural machining and construction requirements from notations on working drawings.
30. List proper procedure for construction of various machining processes.
31. Determine proper thread series and types for duty specific assembly.
32. Specify duty specific uses of contour notes.
33. Determine overall measurements of contoured parts.
34. Explain various terms involved in multiple sections.
35. Identify usages for chamfers and interpret sizes.
36. Define various chamfer terms.
37. Determine the sizing procedures of necks and grooves.
38. Identify various keyway and keyseat standards.

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| <ol style="list-style-type: none"><li>39. Identify usage of geometric symbols.</li><li>40. Define terms relating to geometric tolerancing.</li><li>41. Set standards and tolerances using geometric dimensioning.</li><li>42. Set axis coordinates on numerical control prints.</li><li>43. Determine axis coordinates on ordinate and tabular prints.</li><li>44. Identify casting and forging terms.</li><li>45. Calculate bend setbacks in sheet metals and plate steels.</li><li>46. Identify parts and materials from various reference books and manuals.</li></ol> |
| <b>Connections</b>  |
| <ul style="list-style-type: none"><li>• Common Core State Standards</li><li>• Common Core Technical Standards</li><li>• KOSSA</li><li>• New Generation Science Standards</li><li>• National Center for Construction and Education Research</li><li>• KCTCS Course: BRX 112</li><li>• CTSO - SkillsUSA</li></ul>   |

## Cooling and Dehumidification (Ind.Maint)

Valid Course Code: 470361

**Course Description:** This course explores the science of troubleshooting and the importance of proper maintenance procedures; how to work well with others, communication, and trade responsibilities; actual troubleshooting techniques and how to use schematics and symbols; specific maintenance tasks such as solving mechanical and electrical problems, and breakdown maintenance; and the hows and whys of planned maintenance.

*Prerequisites: Refrigeration Fundamentals (Ind. Maint.) - 470349*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe air conditioning.
5. List the benefits of "conditioned" air.
6. Describe some of today's current issues regarding air conditioning—industry concerns and future ramifications.
7. Describe the difference between "split systems" and "package systems".
8. Describe the sequence of the basic refrigeration cycle and operation of the air conditioning system.
9. Use and read various tools and instrumentation needed for checking, testing, and operating air conditioning systems.
10. Define the types of condensers: air cooled, water cooled, evaporative.
11. Adjust the air flow for proper temperature difference.
12. Describe maintenance of a condenser and a cooling tower.
13. Analyze air conditioning systems and appropriately diagnose the electrical and/or mechanical problems.
14. Demonstrate good customer relations in a classroom simulation.
15. Explain the importance of manufacturers' installation and operation requirements.
16. Determine equipment electrical requirements.
17. Verify equipment air flow and distribution requirements.
18. Check operation of all electrical components including control components.
19. Demonstrate the use of tools and test equipment.
20. Check system operation while following all safety procedures.
21. Follow local codes and ordinances during installation and repair.
22. Read and demonstrate understanding of electrical wiring diagrams.
23. Develop a systematic way to diagnose system problems and demonstrate in class.
24. Determine the cause of failure in a system.
25. Identify and describe possible causes of failure and how to eliminate them.
26. Demonstrate the use of tools and test equipment while following safety practices.
27. Verify system operation.
28. Write a service report.
29. Identify types of control systems: electromechanical, pneumatic, electronic, and programmable.
30. Identify control system components.

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| <ol style="list-style-type: none"><li>31. Describe the sequences of operation in all types of control systems.</li><li>32. Construct a schematic diagram using all components necessary to safely operate an air conditioner.</li><li>33. Program a programmable thermostat for heating, cooling, and heat pump operation including set up and set back.</li><li>34. Plot and chart psychrometric terms.</li><li>35. Describe operation of electronic air cleaner.</li><li>36. Measure pressure drop with a magnahelic gauge.</li></ol> |
| <b>Connections</b>  |
| <ul style="list-style-type: none"><li>• Common Core State Standards</li><li>• Common Core Technical Standards</li><li>• KOSSA</li><li>• New Generation Science Standards</li><li>• National Center for Construction and Education Research</li><li>• KCTCS Course: ACR 250</li><li>• CTSO - SkillsUSA</li></ul>   |

**Co-op I (Ind.Maint)**  
**Valid Course Code: 470305**

**Course Description:** Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.

*Prerequisite: Permission of Instructor*

**Content/Process**

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choice(s).
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.

**Connections**

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 199
- CTSO - SkillsUSA



## Electrical Components (Ind.Maint)

Valid Course Code: 470358

**Course Description:** This course defines the electrical components of an air conditioning system. Different types of line voltages, wiring diagrams, and solid-state devices are included. Safety is emphasized.

*Prerequisites: HVAC Electricity (Ind. Maint.) - 470365*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Measure voltage with digital and analog voltmeters.
5. Measure AC current with a clamp-on ammeter.
6. Measure resistance with an ohmmeter.
7. Check winding insulation with a megohmmeter.
8. Check voltage with a voltage tester.
9. Use a continuity tester to determine whether an open circuit exists.
10. Use a capacitance meter to measure capacitance of both run and start capacitors.
11. Define watts, ohms, volts, and amps.
12. Define and compare single and multi-phase voltage and current.
13. Demonstrate proper use of ohmmeter, ammeter, and voltmeter.
14. Calculate electrical circuit loads.
15. Use appropriate meters to check fuses and breakers.
16. Use appropriate meter to determine wattage, resistance, voltage, and amperage.
17. Interpret tables and charts from National Electrical Code (NEC).
18. Figure wire sizes and voltage drop.
19. Draw and identify power transformer types.
20. Use electrical meters appropriately to test and identify voltages and phase.
21. Size and test fuses and breakers and safely replace them.
22. Use NEC tables to size EMT.
23. Define relays, sequencers, contactors, capacitors, defrost timers, crankcase heaters, water valves, damper actuators, thermostats, controllers, rheostats, zone valves, and solenoids.
24. Explain the operation and application of: split phase motors, three phase motors, variable speed motors, shaded pole motors, and permanent split capacitor motors.
25. Demonstrate proper use of testing equipment for motors.
26. Interpret detailed instructions for wiring circuits.
27. Draw electrical circuits in accordance with standard wiring procedures.
28. Wire actual electrical circuits from wiring diagrams.
29. Demonstrate the use of basic electrical meters by wiring and testing actual circuits.
30. Explain the use of various electrical components in HVACR.
31. Interpret schematic wiring diagrams into a sequence of operation for HVACR equipment.
32. Analyze the electrical performance of each component and control.
33. Rewire a HVACR unit using a schematic diagram.
34. Develop an approved routine for electrical troubleshooting.
35. Use electrical test instruments appropriately to test and correct the performance of

electrical systems.
<b>Connections</b>
<ul style="list-style-type: none"> <li>• Common Core State Standards</li> <li>• Common Core Technical Standards</li> <li>• KOSSA</li> <li>• New Generation Science Standards</li> <li>• National Center for Construction and Education Research</li> <li>• KCTCS Course: ACR 130</li> <li>• CTSO - SkillsUSA</li> </ul>

## Fluid Power

### Valid Course Code: 470321

**Course Description:** This course is a study of fluid power theory, component identification and application, schematic reading, and basic calculations related to pneumatic and hydraulic systems and their operations.

#### Content/Process

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Design simple hydraulic and pneumatic systems.
5. Draw hydraulic and pneumatic circuits.
6. Install pneumatic pressure regulator.
7. Check and replace pneumatic pressure regulator.
8. Install pressure relief valve.
9. Check and replace pressure relief valve.
10. Install non-rotating cylinder.
11. Install hydraulic and pneumatic motors.
12. Install pressure booster (intensifier).
13. Install pressure reducing valve.
14. Install rotating cylinder.
15. Replace 2-way, 3-way, and 4-way valves (solenoid operated valves).
16. Replace an accumulator.
17. Adjust the pressure on hydraulic systems.
18. Change filters in hydraulic systems.
19. Change hydraulic fluid.
20. Install hydraulic pressure regulator.
21. Check and replace hydraulic pressure regulator.
22. Install hydraulic sequence valve.
23. Check and replace hydraulic sequence valve.
24. Install counter-balance valve.
25. Install flow control or speed control valve.
26. Install hydraulic pump.
27. Replace hydraulic cylinder.

#### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: FPX 100
- CTSO - SkillsUSA

## Fundamentals of Machine Tool – A (for Maintenance)

Valid Course Code: 470313

**Course Description:** This course provides the basic principles needed for a solid foundation in machine tool technology. Areas and machines covered include shop safety, bench-work, drill press, power saw, measurement, mills, and lathes.

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate and practice safe work habits in the lab area as outlined in NIMS Framework for Machining Skills.
5. Perform bench work processes, hacksaw, files, layout, drill, tap and other activities to meet industry standards.
6. Perform safe and functional activities on the following machines: horizontal bandsaw, vertical bandsaw, drill press, arbor press, lathes, and mills.
7. Perform tasks with cutting hand tools and non-cutting hand tools.
8. Identify and explain the handling procedure for hazardous material and the content of MSDS.
9. Identify safety needs and regulations in a machine shop.
10. Identify non-cutting hand tools and the proper use of them.
11. Prepare for a benchwork process.
12. Hand saw with a hacksaw.
13. Bench file the workpiece.
14. Dress and true grinding wheels on bench and pedestal grinders.
15. Demonstrate knowledge of power saws, parts, and applications.
16. Demonstrate the care and safe use of the power saw.
17. Cut and weld bandsaw blades.
18. Perform operations on the cut-off saw.
19. Perform operations on the vertical band saw.
20. Demonstrate knowledge of drill press, parts, and applications.
21. Demonstrate the care and safe use of the drill press.
22. Calculate and set the cutting speed and feed on the drill press.
23. Sharpen drills.
24. Set up a drill press and drill holes.
25. Shape and finish holes on a drill press.
26. Tap holes by hand and machine on a drill press.
27. Thread by hand with taps and dies.
28. Operate an arbor press.
29. Use chisels and punches.
30. Demonstrate knowledge of hazardous materials handling.
31. Demonstrate knowledge of hazardous materials storage.
32. Demonstrate lock-out/tag-out procedures.
33. Demonstrate use of MSDS.
34. Measure with basic hand-held measuring instruments.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: CMM 110
- CTSO - SkillsUSA

## Fundamentals of Machine Tool – B (for Maintenance)

Valid Course Code: 470314

**Course Description:** This course provides the basic principles needed for a solid foundation in machine tool technology. Areas and machines covered include shop safety, bench work, drill press, power saw, measurement, mills, and lathes.

*Prerequisites: Fundamentals of Machine Tool A - 470313*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate and practice safe work habits in the lab area.
5. Demonstrate knowledge of lathes, parts, and applications.
6. Demonstrate the care and safe use of lathes.
7. Demonstrate use and knowledge of mill parts and applications.
8. Demonstrate knowledge of cutting tools.
9. Demonstrate knowledge of cutting fluids.
10. Identify and explain the handling procedure for hazardous material and the content of MSDS.
11. Calculate and set speeds and feeds on a lathe.
12. Sharpen high speed tool bits.
13. Mount workpiece on a lathe.
14. Face a workpiece.
15. Perform turning operations.
16. Machine with carbide cutting tools.
17. File and polish a workpiece.
18. Demonstrate knowledge of a milling machine, parts, and applications.
19. Demonstrate the care and safe use of milling machines.
20. Calculate and set speeds and feeds on the milling machine.
21. Mill flat surfaces and grooves using a vertical mill.
22. Apply cutting fluid to machining operations.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: CMM 112
- CTSO - SkillsUSA

## Gas Metal Arc Welding

Valid Course Code: 470367

**Course Description:** This course covers identification, inspection, and maintenance of GMAW machines; identification, selection and storage of GMAW electrodes; principles of GMAW; and the effects of variables on the GMAW process. Theory and applications of related processes such as FCAW and SAW and metallurgy are also included. Students learn the practical application and manipulative skills of Gas Metal Arc Welding and the proper safety situations needed in this process. Both ferrous and non-ferrous metals will be covered, as well as various joint designs on plate in all positions.

### Content/Process

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Apply the technical math required for employment opportunities in welding.
5. Use lab equipment and tools.
6. Apply principles of GMAW to weld metals to include FCAW and SAW.
7. Apply knowledge of the effects of variables of GMAW to weld plate and pipe.
8. Apply knowledge of basic metallurgy to control chemical, physical, and mechanical properties of alloy steels.
9. Identify and select filler materials for GMAW processes.
10. Weld fillet welds in all positions using various transfer modes on steel, stainless steel, and aluminum.

### Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- American Welding Society (AWS) Industry Standards
- KCTCS Course: WLD 140
- CTSO-Skills USA

## Heating and Humidification (Ind. Maint.)

Valid Course Code: 470363

**Course Description:** Explains heating systems from simple fossil fuel furnaces through more complex systems. This course will also concentrate on the line and control voltage circuitry pertaining to these systems. ARI Controls: Subtopics A-C; Heating Systems: Subtopics A-C; System Installation and Start-Up: Subtopics A and B; System Servicing and Troubleshooting: Subtopic C; Tools and Equipment: Subtopic D. This course is designed to develop the practical skills of troubleshooting, checking, adjusting, and installing heating units currently in use.

*Prerequisite: HVAC Electricity (Ind.Maint.) - 470365*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Adjust valves.
5. Check coil resistance of a valve coil.
6. Test gas valve operation.
7. Check the voltage at gas valve operator.
8. Check pressure at inlet vs. outlet of gas valve.
9. Perform a regular conversion on a gas valve from natural gas to LP or reverse: low, line voltage, redundant, two-stage, and modulating.
10. Explain the operation of a solenoid valve.
11. Explain direct vs. servo regulation.
12. Identify limited, non-adjustable and adjustable regulators.
13. Determine application of gas valves.
14. Differentiate between pilot proving devices.
15. Explain the operation of flame rod, mercury flame switch, bimetal, and millivolt flame sensors.
16. Test and change a thermocouple flame sensor.
17. Test spark ignition modules.
18. Perform safety lockout procedures for burners.
19. Measure resistance of a cad cell during operation.
20. Explain the operation of an oil delay valve.
21. Identify and install residential heating and cooling thermostats.
22. Test a fan/limit control to identify a set point of control.
23. Wire a complete heating system—line and low voltage.
24. Identify controls for heating and cooling.
25. Wire a humidistat into electrical circuit.
26. Wire control circuit for electronic air cleaner.
27. Test and adjust the fuel system of furnace.
28. Check the ignition system.
29. De-rate or change over a gas burner.
30. Adjust burner system to recommended efficiency.
31. Check for proper temperature rise across the furnace.
32. Test all safety controls.



33. Set proper air distribution in house.
34. Remove, install, and adjust blower motor and/or belt.
35. Clean the pilot assembly.
36. Adjust the regulator.
37. Observe proper draft conditions.
38. Oil motor(s) and bearings.
39. Check and adjust the heat anticipator.
40. Check circulator for alignment and lubrication.
41. Set aquastat.
42. Check water-regulating valve operator.
43. Inspect/change zone valve operator.
44. Remove air from water system.
45. Wire a multizone/multipump hydronic system.
46. Identify types of hydronic piping systems.
47. Test boiler efficiency and clean if necessary.
48. Oil motor(s).
49. Check and adjust the heat anticipator.
50. Perform pressure checks on the fuel system.
51. Perform pressure checks on the venting system.
52. Measure temperature difference across heating and cooling equipment.
53. Adjust individual register outlets to properly balance system.
54. Describe the reasons for codes.
55. Discuss three model codes: Boca, standard, uniform.
56. Identify the codes and standards for the applicable area, locality, or state.
57. Discuss the relationship between codes and manufacturers' installation instructions.
58. Identify standards not covered by codes: ARI, ASHRAE, SMACNA.
59. Demonstrate good customer relations in a classroom simulation.
60. Explain the importance of manufacturers' installation and operation requirements.
61. Determine equipment electrical requirements.
62. Verify equipment air flow and distribution requirements.
63. Check operation of all electrical control components.
64. Check operation of gas train components and measurements.
65. Demonstrate use of tools and instruments.
66. Check oil burner components and measurements.
67. Check ignition systems while following all safety principles.
68. Evaluate fuel supply systems.
69. Test for proper combustion.
70. Check electrical components for operation and wiring connections.
71. Check for correct heating input and adjust to manufacturers' specifications.
72. Read electrical wiring diagrams and demonstrate an understanding of wiring diagrams.
73. Use tools and test equipment appropriately while following safety practices.
74. Demonstrate an understanding of combustion theory.
75. Determine air requirements.
76. Develop a systematic way to diagnose system problems and demonstrate in class.
77. Determine cause of failure in a heating system.
78. Identify and describe all possible causes of failure and how to eliminate causes.
79. Verify system operation.
80. Write a service report.

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| <ol style="list-style-type: none"><li>81. Measure chimney draft with a draft gauge.</li><li>82. Perform an efficiency test on an oil-gas burner: smoke test, CO<sub>2</sub> test, and O<sub>2</sub> test.</li><li>83. Determine the efficiency of an oil pump using a vacuum gauge and a pressure gauge.</li><li>84. Determine the relative humidity using a sling psychrometer.</li><li>85. Measure gas pressure with a U-tube manometer.</li></ol> |
| <b>Connections</b>   |
| <ul style="list-style-type: none"><li>• Common Core State Standards</li><li>• Common Core Technical Standards</li><li>• KOSSA</li><li>• New Generation Science Standards</li><li>• National Center for Construction and Education Research</li><li>• KCTCS Course: ACR 260</li><li>• CTSO - SkillsUSA</li></ul>  |

## HVAC Electricity (Ind.Maint)

Valid Course Code: 470365

**Course Description:** This course introduces students to the basic physics of electricity. Students apply Ohm's law; measure resistance, voltage, ohms, watts and amps; construct various types of electrical circuits; select wire and fuse sizes; and learn to troubleshoot an electric motor and motor controls.

### Content/Process

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Measure ohms with an ohmmeter.
5. Measure voltage with a voltmeter.
6. Measure amps with an ammeter.
7. Measure watts with a wattmeter.
8. Solve electrical circuit problems using Ohm's Law.
9. Draw and interpret electrical symbols.
10. Construct series circuits.
11. Construct parallel circuits.
12. Construct series-parallel circuits.
13. Connect, operate, and identify the types of single-phase motors.
14. Measure the resistance of windings in a split-phase motor and identify the start/run windings.
15. Test capacitors.
16. Select wire and fuse sizes.
17. Test transformers.
18. Locate faults in electrical circuits.
19. Identify types of 3-phase power supplies.
20. Troubleshoot magnetic motor starters and coils.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: ACR 102
- CTSO - SkillsUSA

## Industrial Maintenance Electrical Motor Controls

Valid Course Code: 470348

**Course Description:** This course addresses the diversity of electric motor control devices and applications used in industry today with safety and electrical lockouts included.

*Prerequisite: Industrial Maintenance Electrical Principles - 470322*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Connect control relay systems.
5. Connect a dynamic breaking circuit for AC motors.
6. Test magnetic starters.
7. Connect overload relays into starting control circuits.
8. Connect reduced voltage starters.
9. Connect time delay relays.
10. Connect motor for automatic controls.
11. Connect automatic reduced voltage starter for DC motor control.
12. Connect control relay systems.
13. Connect limit switches.
14. Connect motor control circuits for plug-ins.
15. Connect point starters for DC motors.
16. Connect push button stations.
17. Connect selector switches.
18. Connect sensing devices (non-electric).
19. Connect magnetic starters.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 220
- CTSO - SkillsUSA

# Industrial Maintenance Electrical Principles

Valid Course Code: 470322

**Course Description:** This course introduces the theory of electricity and magnetism and the relationship of voltage, current, resistance, and power in electrical circuits. The course is designed to develop an understanding of alternating and direct current fundamentals. Students will apply formulas to analyze the operation of AC and DC circuits.

## Content/Process

### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Review and apply OSHA Standards and National Electrical Code.
5. Care for, maintain, identify and use basic hand tools.
6. Solder/de-solder electrical connections.
7. Set up and operate power supplies.
8. Compute, measure, and identify conductance and resistance of conductors and insulators.
9. Measure properties of a circuit using VOM and DMM meters.
10. Solve electrical circuit problems using Ohm's Law.
11. Analyze, construct and troubleshoot parallel circuits.
12. Analyze, construct and troubleshoot series circuits.
13. Analyze, construct and troubleshoot series-parallel circuits.
14. Determine physical and electrical characteristics of capacitors and inductors.
15. Analyze basic motors, generator theory and operation.
16. Write technical reports.
17. Use an oscilloscope to verify properties of an AC signal.
18. Determine physical and electrical characteristics of transformers and test procedures.
19. Compute and measure power in AC circuits.
20. Apply and demonstrate the Edison system and the three phase system.
21. Analyze and identify circuit protection.
22. Connect various transformer configurations.
23. Wire two- and three-way switches.
24. Wire single phase circuit.
25. Install, identify and label circuit breakers, fuses and other overload protection in distribution panels.
26. Identify appropriate wiring sizes and amperage ratings.
27. Identify and install appropriate wiring techniques.
28. Install conductors in various forms of conduit/raceways.

## Connections

- Common Core State/Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 110
- CTSO - SkillsUSA

## Industrial Maintenance of PLC's

Valid Course Code: 470330

**Course Description:** This course includes the theory of Programmable Logic Controllers to include installation, programming, interfacing, and troubleshooting PLC's.

*Prerequisite: Industrial Maintenance Electrical Motor Controls - 470348*

### Content/Process

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe basic operation of programmable controllers.
5. Apply language functions and symbols used in PLC.
6. Translate relay logic to PLC logic.
7. Fabricate I/O configurations using serial and parallel.
8. Design simple programmable controller applications.
9. Program PLCs.
10. Install PLCs to replace relay systems.
11. Install PLCs to operate fluid power systems.
12. Plan a shutdown procedure for PLC-managed equipment.
13. Troubleshoot hardware faults using PLCs.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 230
- CTSO - SkillsUSA

**Internship (Ind.Maint)**  
**Valid Course Code: 470308**

**Course Description:** The Internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Internship do not receive compensation.

*Prerequisite: Permission of Instructor*

**Content/Process**

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choice(s).
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.

**Connections**

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 198
- CTSO - SkillsUSA

## Maintaining Industrial Equipment

Valid Course Code: 470318

**Course Description:** This course is designed to introduce the student to maintenance techniques and procedures used to maintain industrial equipment.

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe the care and safe use of maintenance tools, equipment and components, e.g., lock-out/tag-out, rigging, electrical safety.
5. Describe lubrication techniques used on machines and components.
6. Identify various types of bearings and seals.
7. Explain the replacement procedure for bearings and seals.
8. Explain alignment of couplings using straight edge and feeler gauge, dial indicator methods, and laser.
9. Explain the mounting and operation of centrifugal pumps and motors.
10. Explain the mounting and operation of speed reduction/speed increase assemblies.
11. Explain the mounting and operation of clutch and brake assemblies.
12. Identify common belts, e.g., V-Belt, timing.
13. Explain the tensioning and alignment of various belts.
14. Identify common types chains, e.g., roller, silent.
15. Explain the tensioning and alignment of various chains.
16. Explain the alignment of sprockets and sheaves.
17. Explain the installation and adjustment variable of pitch sheaves.
18. Explain the common types of gears, e.g., spur, helical.
19. Describe the maintenance of open and closed gearing.
20. Explain the diametral pitch and gear meshing.
21. Explain vibration analysis in troubleshooting.
22. Identify various fasteners, key and keyways, and bolts.
23. Explain set-up, lighting and using Oxyfuel cutting equipment.
24. Perform lubrication techniques on machines and components.
25. Replace bearings and seals.
26. Align couplings using; straight edge and feeler gauge, dial indicator methods, and laser.
27. Mount and operate centrifugal pumps and motors.
28. Mount and operate speed reduction/speed increase assemblies.
29. Mount and operate clutch and brake assemblies.
30. Adjust tension and alignment of various belts.
31. Adjust tension and alignment of various chains.
32. Align sprockets and sheaves.
33. Install and adjust pitch sheaves.
34. Maintain open and closed gearing.
35. Use vibration analysis in troubleshooting.
36. Perform straight line, piercing, beveling with oxyfuel cutting equipment.

### Connections



- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 150
- CTSO - SkillsUSA

## Refrigeration Fundamentals (Ind.Maint)

Valid Course Code: 470349

**Course Description:** The student is introduced to the fundamentals of refrigeration, refrigeration terms, and the basic refrigeration cycle. Proper use of tools, test equipment, and materials is stressed. Environmental issues including refrigerant handling are discussed. Refrigerant piping and methods used to join them are taught. General and specific safety is emphasized.

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Explain the history of refrigeration.
5. Compare the benefits of closed vs. open system.
6. Identify and explain the operation of the four major components.
7. Identify the high and low sides of the system.
8. Define matter and heat.
9. Distinguish between the three states of matter.
10. Explain the direction and rate of heat flow.
11. Describe the three methods of heat transfer.
12. Identify the reference points of temperature: boiling point, freezing point, critical temperature, absolute zero.
13. Explain the difference between heat and temperature.
14. Explain the differences between latent and sensible heat.
15. Explain the relationship of pressures and fluids at different temperatures.
16. Calculate absolute and gauge pressures.
17. Measure absolute and gauge pressures.
18. Explain how fluids react in a closed vs. open system.
19. Compare temperature with pressure (P/T Chart).
20. Explain why fluids flow.
21. Define the properties of refrigerants.
22. Explain the uses of different refrigerants.
23. Identify color coding of refrigerant cylinders.
24. Explain classifications of refrigerants.
25. List proper transfer and storage of refrigerants.
26. Explain the four parts of the refrigeration cycle.
27. Draw a refrigeration system on a pressure-enthalpy (Ph) chart.
28. Explain the benefits of superheat and sub cooling.
29. Identify the effects of improper refrigerant in a system.
30. Identify basic tools and accessories: various screwdrivers, nutdrivers, socket wrenches, Allen (hex) wrenches, open- and box-end wrenches, flare wrench, etc.
31. Identify power tools: general-purpose drill, power screwdriver, hammer drill, reciprocating saw, screw-gun, etc.
32. Identify fasteners: bolts, screws, masonry anchors, various electrical connectors, conduit, pipe and cable clamps, nails, etc.
33. Identify pipe and tubing tools: pipe cutters, reamers and threaders, tubing cutters and reamers, benders, flaring tools, swaging tools, pipe vises, etc.

34. Describe lubrication methods utilizing: grease guns, oilers, sprays.
35. Measure pressures with the refrigeration gauge manifold.
36. Evacuate systems with a two-stage vacuum pump.
37. Measure vacuums with a thermistor vacuum gauge.
38. Measure temperatures with various thermometers.
39. Charge a system with an electronic charging scale.
40. Check for leaks with electronic leak detector dye and electrosonic.
41. Identify types of pipe and tubing used in refrigeration work.
42. Identify various types of fittings.
43. Describe methods of insulating pipe and tubing.
44. Identify soldering and brazing alloys used in HVACR.
45. Explain applications of soldering and brazing alloys.
46. Flare, swag, and bend copper tubing.
47. Identify types of torches.
48. Solder and braze copper tubing.
49. Cut and thread iron pipe.
50. Describe heat sink methods.
51. Describe heat exchange techniques.
52. Explain saturation temperature.
53. Determine the METD (Mean Effective Temperature Difference).
54. Check for and repair refrigerant leaks.
55. Measure temperatures with bimetal and glass stem thermometers.
56. Describe the applications of vibration eliminators.
57. Identify types of evaporators: bare-tube, finned, plate, unit coolers, chillers.
58. Explain the operation performance of a condenser.
59. Charge system with refrigerant on liquid side as well as suction side.
60. Test and adjust all operating and safety controls.
61. Replace filter driers.
62. Inspect electrical circuit for defective connections.
63. Repair defective connections.
64. Interpret wiring diagram.
65. Clean drain line.
66. Check all electrical components for voltage and current.
67. Check and/or change compressor oil.
68. Clean condenser coil surface (air cooled/water cooled).
69. Perform all aspects of preventive maintenance.

#### **Connections**

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: ACR 100
- CTSO - SkillsUSA

## Robotics and Industrial Automation (Ind.Maint)

Valid Course Code: 470351

**Course Description:** This course provides an introduction to the theory of robots including terminology, components, and basic programming. Provides theory of servo and non-servo robots. Topics include robot types, controllers, manipulators, basic robotic programming, and fluid power systems. Provides basic theory of flexible and computer-integrated manufacturing and control systems.

*Prerequisites: Motor Control Concepts - 470333*

### Content/Process

#### Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Explain the set-up, repair, and maintenance of automatic machines.
5. Explain the set-up, repair, and maintenance of processing equipment.
6. Explain the set-up, repair, and maintenance of robots that work together as part of a total automated manufacturing system.
7. Develop cost/benefit analysis for automation.
8. Develop case studies for improving production, efficiency, and profitability.
9. Analyze, summarize, and interpret major factors in automation to include operator training, teamwork, resistance, and organized labor.
10. Analyze and develop safety strategies for automated systems.
11. Develop on-line and off-line robot programs.
12. Describe components in the integrated manufacturing environment.
13. Demonstrate knowledge of robot terminology.
14. Read and understand technical manuals.
15. Explain how to perform preventative maintenance.
16. Identify and describe the functions of vision systems.
17. Describe open loop and closed loop control.
18. Demonstrate knowledge of servo and non-servo systems.
19. Demonstrate knowledge of robot classifications.
20. Define computer-integrated manufacturing (CIM) systems.
21. Develop a safety strategy for automated work cells to include risk assessment and risk reduction.
22. Demonstrate leadership skills.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: ELT 260
- CTSO - SkillsUSA

## Shielded Metal Arc Welding (Ind.Maint)

Valid Course Code: 470354

**Course Description:** Teaches students the identification, inspection, and maintenance of SMAW electrodes; principles of SMAW; the effects of variables on the SMAW process to weld plate and pipe; and metallurgy.

### Content/Process

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Identify, select, and store SMAW electrodes.
5. Apply principles of SMAW process to cut and weld metals.
6. Apply the knowledge of the effects of variables on the SMAW process to weld plate and pipe.
7. Apply the knowledge of basic metallurgy to control chemical, physical, and mechanical properties of carbon steel.
8. Use shop equipment and tools.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: WLD 120
- CTSO - SkillsUSA

**Shop Management**  
**Valid Course Code: 470301**

<b>Course Description:</b> This course introduces the basic principles of sound and efficient shop management. Inventory control, fiscal management, and customer relations are emphasized.	
<b>Content/Process</b>	
<b>Students will:</b> <ol style="list-style-type: none"><li>1. Practice and perform safe shop procedures at all times.</li><li>2. Apply the technical math required for employment opportunities in maintenance.</li><li>3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.</li><li>4. Maintain tools and equipment.</li><li>5. Develop customer relations skills.</li><li>6. Prepare work orders.</li><li>7. Maintain inventory.</li><li>8. Maintain service records.</li><li>9. Supervise personnel.</li><li>10. Prepare parts requisition.</li><li>11. Provide fiscal management.</li><li>12. Complete an incident report.</li></ol>	
<b>Connections</b>	
<ul style="list-style-type: none"><li>• Common Core State Standards</li><li>• Common Core Technical Standards</li><li>• KOSSA</li><li>• New Generation Science Standards</li><li>• National Center for Construction and Education Research</li><li>• KCTCS Course: MOT 130</li><li>• CTSO - SkillsUSA</li></ul>	

## Special Topics – Industrial Maintenance Technology

Valid Course Code: 470336

**Course Description:** Special Topics is designed to enhance a student's understanding of problem solving in industrial situations. It expands on the task lists that have already been taught to the student in previous industrial maintenance courses.

*Prerequisite: Instructor Permission*

### Content/Process

**Students will:**

1. Complete selected tasks/problems as determined by instructor.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 290
- CTSO - SkillsUSA

## Welding for Maintenance

Valid Course Code: 470328

**Course Description:** This course will provide basic instruction needed for student to weld using SMAW, MIG, TIG and Oxy-Fuel.

### Content/Process

**Students will:**

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe the selection, care, and storage of oxy-fuel cutting equipment.
5. Explain the identification, selection, and storage of SMAW electrodes.
6. Apply principles of SMAW process to cutting welding metals.
7. Describe the set up and use of SMAW welders.
8. Explain the application of basic metallurgy principles to control chemical, physical, and mechanical properties of carbon steel.
9. Explain the proper use of shop equipment and tools.
10. Explain the set up and use of MIG welders.
11. Explain the set up and use of TIG welders.

### Connections

- Common Core State Standards
- Common Core Technical Standards
- KOSSA
- New Generation Science Standards
- National Center for Construction and Education Research
- KCTCS Course: IMT 100
- CTSO - SkillsUSA